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July 31, 2001

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

BY HAND

Ms. Magalie R. Salas
Secretary
Federal Communications Commission
445 Twelfth Street, S.W.
Washington, D.C. 20554

RE: *WorldCom, Cox, and AT&T v. Verizon*
CC Docket Nos. 00-218, 00-249, and 00-251

Dear Ms. Salas:

Enclosed for filing please find 4 public versions of Verizon Virginia Inc.'s ("Verizon VA") direct testimony in the above-referenced arbitration proceedings. The direct testimony consists of four volumes. Volumes I-III of the testimony contain proprietary information that has been redacted from the publicly available copies.

Verizon VA is also serving 8 copies (and 3 electronic copies) of the non-public versions of the testimony, as well as 2 copies of the public versions, on Commission staff.

Verizon VA is providing AT&T/WorldCom the proprietary versions of Volumes II and III, which contain information proprietary to Verizon VA, pursuant to the protective order issued in this case on June 6, 2001. Verizon VA is not, however, providing AT&T/WorldCom with the proprietary version of Volume I because it contains information proprietary to other CLECs. Instead, Verizon VA will provide AT&T/WorldCom only the information in Volume I proprietary to them.

Please call Scott Randolph (202-515-2530) or me if you have any questions.

Very truly yours,

Catherine Kane Ronis

Catherine Kane Ronis
Attorney for Verizon Virginia Inc.

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cc: Dorothy Attwood (8 proprietary copies; 2 public copies)
Mark A. Keffer (1 public and 1 proprietary copy)
Jodie L. Kelley (1 public and 1 proprietary copy)
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Scott Randolph (w/o enclosures)
Lydia R. Pulley (w/o enclosures)
Kelly L. Faglioni (w/o enclosures)

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of Petition of WorldCom, Inc. Pursuant to Section 252(e)(5) of the Communications Act for Expedited Preemption of the Jurisdiction of the Virginia State Corporation Commission Regarding Interconnection Disputes with Verizon Virginia Inc., and for Expedited Arbitration	)	CC Docket No. 00-218
In the Matter of Petition of Cox Virginia Telecom, Inc. Pursuant to Section 252(e)(5) of the Communications Act for Preemption of the Jurisdiction of the Virginia State Corporation Commission Regarding Interconnection Disputes with Verizon Virginia Inc. and for Arbitration	)	CC Docket No. 00-249
In the Matter of Petition of AT&T Communications of Virginia Inc., Pursuant to Section 252(e)(5) of the Communications Act for Preemption of the Jurisdiction of the Virginia Corporation Commission Regarding Interconnection Disputes With Verizon Virginia Inc.	)	CC Docket No. 00-251

VERIZON VIRGINIA INC.'S
DIRECT TESTIMONY

CERTIFICATE OF SERVICE

I do hereby certify that true and accurate copies of the foregoing, Verizon Virginia Inc.'s Direct Testimony, Volumes I-IV, were delivered this 31st day of July, 2001, by hand to:

Mark A. Keffer
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Catherine K. Ronis

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of Petition of WorldCom, Inc. Pursuant to Section 252(e)(5) of the Communications Act for Expedited Preemption of the Jurisdiction of the Virginia State Corporation Commission Regarding Interconnection Disputes with Verizon Virginia Inc., and for Expedited Arbitration	)	CC Docket No. 00-218
In the Matter of Petition of Cox Virginia Telecom, Inc., etc.	)	CC Docket No. 00-249
In the Matter of Petition of AT&T Communications of Virginia Inc., etc.	)	CC Docket No. 00-251

VERIZON VIRGINIA INC.
VOLUME I OF IV

DIRECT TESTIMONY
(Public Version)

- Economic Foundations
- State of Competition in Virginia
- Cost of Capital
- Depreciation

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

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VERIZON VIRGINIA INC.

Testimony of Dr. Howard Shelanski

July 31, 2001

TABLE OF CONTENTS

I. INTRODUCTION
(JDPL Issues II-1-a to II-1-c; II-2-a to II-2-c)

A. STATEMENT OF QUALIFICATIONS

Q. What is your current position and your educational and professional background?

A. My current position is Acting Professor of Law at the University of California at Berkeley. I received my B.A. from Haverford College in 1986, my J.D. from the University of California at Berkeley in 1992, and my Ph.D. in economics from the University of California at Berkeley in 1993. I have been a member of the Berkeley faculty since 1997. In 1998-2000 I was on leave from my faculty position to serve as a Senior Economist to the President's Council of Economic Advisers (1998-99) and then as Chief Economist of the Federal Communications Commission (1999-2000). I rejoined the Berkeley faculty on a full time basis in July 2000. I formerly practiced law in Washington, D.C. with the firm of Kellogg, Huber, Hansen, Todd and Evans and served as a law clerk to Justice Antonin Scalia of the U.S. Supreme Court.

I teach and conduct research in the areas of telecommunications regulation, antitrust, and applied microeconomics. My recent publications include articles in the *Journal of Law, Economics and Organization*, the *Yale Journal on Regulation*, the *University of Chicago Law Review*, the *Journal of Law and Economics*, the *University of Chicago Legal Forum*, and the *Columbia Law Review*. I am co-author of the recently published legal textbook *Telecommunications Law and Policy* (Carolina Academic Press, 2001). I am a regular participant in academic conferences related to telecommunications policy and antitrust and lecture regularly on both topics at universities in the United States and abroad. I have served as a referee for a number of economics journals and am an editor of the *International Review of Law and Economics*. My C.V. is provided as Attachment A.

B. PURPOSE OF TESTIMONY

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to outline the economic principles for determining the forward-looking costs of providing unbundled network elements (UNEs), and to apply those principles in evaluating Verizon VA's cost studies and their compliance with the FCC's TELRIC framework.[1] This testimony will also examine the manner in which Verizon VA measures and proposes to recover the non-recurring costs of providing competitors with access to UNEs.

C. PRINCIPAL CONCLUSIONS

Q. Please summarize your testimony and the principal conclusions of your analysis.

A. Based on generally accepted economic principles and on my review of Verizon VA's methodology for calculating UNE costs in Virginia, I have reached the following conclusions:

(i) UNE prices should be based on the incremental costs that an efficient firm expects to incur going forward. A carrier's cost study should be designed to reflect the forward-looking costs of deploying an efficient configuration of technologies over an economically reasonable planning period.

[1] My testimony here takes as a given the Commission's conclusion that prices for unbundled network elements should be set based on forward-looking costs. Consequently, I do not address whether or how unrecovered historical costs should be recovered.

(ii) Verizon VA's model for calculating network element costs in Virginia is, to the extent possible under the Commission's TELRIC rules, based on efficient, forward-looking economic principles that account for the incremental costs of using network elements. It accordingly complies with a reasonable interpretation of the Commission's TELRIC regime.

(iii) Verizon VA's cost model neither considers the sunk costs of existing network facilities nor leads to recovery of the embedded costs of Verizon VA's actual network. Even if a cost model were to assume the continued use of some existing facilities (which Verizon VA's recurring cost model does not, except insofar as those facilities already *are* the best available today), the model would not necessarily measure embedded costs. Rather, where existing facilities can be efficiently used, they will incur depreciation and capital costs on a forward-looking basis, and those costs are appropriate to include in a TELRIC study. Verizon VA's model of recurring costs does not, however, assume the long-run use of any existing facilities that are not already the best available and no attempt is made to recover the costs of such plant.

(iv) Verizon VA's model is long-run. Although a long-run economic analysis is, in theory, one in which all inputs of production are variable, a firm in the real world must be able to make efficient decisions about what its existing inputs should be varied *to*. In a dynamic industry like telecommunications, uncertainty about future market and technological conditions is likely to make it hazardous for a firm to assume that all of its current inputs should be varied to the technology that is today the best available or the best expected to be available. A firm engaging in a long-run analysis of network optimization must therefore balance the ideal of making as much of the network costs as possible variable against the real risks of future changes in technology or demand conditions that could render today's investments obsolete sooner than anticipated. These costly risks mean that an efficient firm, even while trying to make its cost study as long-run as possible, will be constrained to examine a finite period over which risk and uncertainty are efficiently managed but over which not all inputs may in fact be varied. Verizon VA's use of a three-year time horizon is thus consistent with a long-run analysis.

(v) The depreciation rates incorporated into Verizon VA's cost model are based on economically correct assumptions about the value of facilities used to provide UNEs on a forward-looking basis. The costs of capital in the model are calculated based upon the same forward-looking economic principles used to measure other network costs.

(vi) Verizon VA's cost model is conservative and, to the likely benefit of new entrants into the local exchange market, assumes more advanced network technology than Verizon VA will in fact have in place at the end of the planning period. This strong, forward-looking assumption could have the effect of causing Verizon VA's model to understate the costs Verizon VA will in fact incur to provide network elements.

(vii) Verizon VA's method of measuring and recovering the non-recurring costs of providing access to unbundled network elements is both economically correct and competitively non-discriminatory.

II. CORRECT ECONOMIC PRINCIPLES FOR A UNE COST STUDY (JDPL Issues II-1-a TO II-1-c; II-2-a to II-2-c)

A. UNE PRICES SHOULD BE BASED ON THE FORWARD-LOOKING COSTS OF THE FIRM PROVIDING UNES.

Q. How should the forward-looking costs of providing network elements be estimated?

A. Costs should be estimated such that the prices based on them create efficient incentives for both new entrants and incumbents. Network element prices will be economically efficient if they encourage competitors to make correct decisions about when to use incumbent networks versus when to look elsewhere for inputs or to build their own facilities. If prices for UNEs are too low, they will deter efficient construction of new facilities and induce inefficiently high usage of incumbent networks. Prices that are too low will also negatively distort the network investment decisions of the incumbent firms constrained to charge such prices. If, on the other hand, UNE prices are too high, they may deter market entry and encourage wasteful investment in new plant by sending incorrect cost signals to new entrant.

Properly determined forward-looking costs for UNEs should thus, in principle, reflect the costs that Verizon VA, acting efficiently over time, expects to incur going forward. In that way, if a competitor can provide the same function more efficiently using its own facilities, then it will have the appropriate incentives to do so. This is not to say that a forward-looking model should base its estimates on the total costs of currently installed network facilities. Instead, it should try to measure the incremental costs that an efficient, cost-minimizing firm expects to incur as it replaces and expands network facilities over time.

Q. Should a forward-looking cost study ignore a carrier's existing facilities?

A. No. An economically correct cost study should not discard the entire existing network and proceed based on the assumption that the firm has instantaneously built a hypothetical, new network from scratch. Rather, a carrier's cost study should be based on the forward-looking costs of deploying an efficient mix of technologies over an economically reasonable planning period (to be discussed below). By "efficient" I mean that the firm's engineering guidelines should call for deployment of the technology that will, *over time*, allow the firm to minimize the costs of network elements that can perform at required levels of reliability and functionality.

Q. What might constrain the rate at which a firm deploys new technology over time?

A. Three factors give rise to costs that might offset the efficiency of new technology and constrain the speed of network replacement: (1) current network facilities that can still be efficiently used and whose remaining economic value would be lost through premature replacement; (2) anticipated, future technological changes that make it more efficient to wait to replace some network facilities rather than to replace them with technology that is the best available today, but will be obsolete tomorrow; and (3) risk and uncertainty regarding unanticipated changes in technology and market demand. An economically correct cost study should both recognize any economic value of existing network facilities and manage uncertainty about future technological changes and future demand for existing network functions, as well as for new kinds of network capabilities that might develop.

A rational carrier thus will usually invest incrementally in new facilities throughout the life of the network instead of immediately replacing the network with each discrete jump in network technology. The firm's analysis begins with the existing state of the network and moves forward. The efficient mix of technology will likely include some amount of existing plant and will evolve over time. Indeed, an efficient firm should replace and expand network facilities so that it moves towards what at any point in time is the optimal, lowest-cost network, but not so quickly that it incurs costs that offset the efficiencies of new technology.

Q. Does your analysis imply that a firm should take into account the unrecovered sunk costs of its existing facilities when deciding whether to replace those facilities or when conducting forward-looking cost studies?

A. No, neither an efficient investment decision nor a forward-looking cost study should account for the sunk costs of installed plant. If the net present value (NPV) of purchasing, operating, and maintaining new facilities is less than the NPV of operating and maintaining installed facilities, then replacement may be warranted. Unrecovered, embedded costs of the installed equipment do not in any way factor into the analysis. The inclusion of existing facilities in a forward-looking cost study should not be confused with inclusion in the study of the embedded costs of those facilities. To recognize that installed plant may have *forward-looking* economic value that should be recovered (*e.g.*, in the form of depreciation and cost of capital) is entirely different from saying that the same plant has historical costs that should be recovered.

B. A LONG-RUN, FORWARD-LOOKING STUDY SHOULD NOT ASSUME THAT FIRMS VARY ALL INPUTS OVER THE PLANNING PERIOD.

Q. What is the economic definition of a "long-run" analysis?

A. A long-run analysis is one in which nothing is fixed and in which all inputs and costs are assumed to be variable. The purpose of a long-run economic analysis is to determine what a firm's optimal cost structure would be if it could change all aspects of its current production technology.

Q. Does that mean that a firm's long-run cost study must vary all existing inputs to yield efficient results and comply with economic principles?

A. No. Although the goal of a long-run, forward-looking analysis is to minimize the degree to which a firm's investment decisions are constrained by previous choices about the size, design, or technology of its network, it might not be efficient for the firm to assume that all inputs change even in a long-run study. A firm's long-run model should allow for the *possibility* that all inputs are variable. But it need not, and in the real world probably will not, assume that all inputs are in fact varied. Before an existing input is varied, the firm must be able reasonably to predict *how* that input should be assumed to change in the model; *i.e.*, it must be able rationally to calculate what an input should vary *to*.

If technology is changing over time, the firm might be able to make reasoned predictions about what the replacement technology and its associated costs will be for only a limited time into the future. At some point, the cost model becomes too speculative to serve the purpose of guiding efficient investment and pricing decisions. The firm's cost study might in practice therefore be able to have only a limited time horizon, over which it is not efficient to assume that all inputs change.

Q. Shouldn't the firm then just assume that all existing inputs have been replaced with the best available technology that can reasonably be incorporated into its cost study?

A. No. This question raises a point of central importance. A rational firm does not automatically jump immediately from its existing network to what would, at that moment, be foreseeable as the technologically optimal network, discarding its installed assets and rebuilding its facilities from scratch. The existing network likely has economic value, meaning that continuing to maintain and operate some current facilities will be less costly than writing off those facilities and immediately replacing them with more advanced technology. A "flash cut" to the long run would discard such economic value of current facilities.

Instead, efficient firms add and replace network plant on an incremental rather than total basis. They replace existing plant only when it loses economic value — *i.e.*, when it becomes more expensive for the firm to maintain and operate an existing facility going forward than it would be for the firm to purchase and operate newer technology, taking into account in this calculation anticipated future developments in demand and technology.

Put differently, it is important to recognize that, when the starting point of the investment analysis is an existing network rather than a blank piece of paper, the efficient mix of technology going forward may differ from the most advanced technology available. Consider, for example, a network that contains mostly copper cable. A new network built today would likely minimize costs by deploying significantly more fiber-optic cable and much less copper than is currently installed. If we assume that to be the case, then the firm starting from scratch might build a network whose proportions of fiber and copper look like the inverse of what we actually see in place today. But that does not mean that the firm owning the existing, mostly copper, network should tear out copper cable and replace it with glass. It is likely to be more efficient for the operator to move forward *incrementally* with some mix of copper and fiber — a mix that takes into account the existing network as a whole with all its complementary and inter-operating parts, as well as risk factors for changing technology and demand — as it expands and replaces its network.

Q. How does a firm determine whether to use existing plant or to replace that plant with new technology going forward?

A. This is the crucial calculation. Suppose a firm has a number of switches of different vintages in a central office. The firm will not likely replace all of those switches the moment a better switch is available for deployment. But the new technology does reduce the economic value even of those switches that are not replaced. Here is why: as already mentioned, a firm will consider replacing a switch when the net present value of the costs of operating and maintaining that switch exceed the net present value of the costs of purchasing, operating, and maintaining the new switch. In a static model in which costs and technology are held constant, the existing switch ceases to have economic value for the network at that point. (If technology will continue to change, the existing switch could still have value because the firm might rationally decide to keep using it and wait for yet further technological developments before upgrading, as I discuss below.) For an existing switch is valuable only to the extent that the firm incurs lower costs over time in keeping it rather than replacing it. As the efficiency of new switches improves, the narrower the differential between the incremental costs (operating and maintenance costs) of the existing switches and the total forward-looking costs of the new switch, and hence the lower the economic value of the existing switches, even if the carrier continues to use them. The important general point is that, even if a carrier does not immediately deploy the latest technology throughout its network, that new technology constrains the economic value of relevant installed equipment.

Q. Based on what you say above, can it be concluded that efficient engineering guidelines should always call for immediate replacement of existing facilities when lower-cost facilities become available?

A. No. Another complexity in a forward-looking cost analysis is that a rational firm will not always replace a piece of equipment the moment that its operation and maintenance costs become higher than the costs of buying, operating, and maintaining the most advanced new version of such equipment. To understand why, keep in mind two things: first, a rational firm looks ahead and considers not only the best technology available today, but also the possibility that something even better might become available later; second, although an efficient firm does not take the sunk costs of installed equipment into account in deciding when to replace that equipment, it *does* take into account the costs of purchasing the new piece of equipment and the possibility that such costs might not be recovered if yet a better technology suddenly comes along. Taken together, these points explain why an economically rational firm may wait to replace installed equipment even when a lower-cost technology becomes available. For, if that lower-cost technology will itself be superseded, it might be less costly in the long run for the firm to wait until the superseding technology comes along — in essence to skip a generation of technology and to wait for something even better.

A rational firm does not take into account the sunk costs of existing equipment in making its forward-looking investment decisions. But a rational firm *does* take into account the risk of stranding unrecoverable sunk costs in the future. In deciding whether to replace its existing equipment when something more efficient comes along, the firm takes into account the risk that it might find itself too quickly having to write off the sunk costs of the new equipment when technology advances yet again. As a result, any model that assumes immediate replacement of installed plant the moment a more efficient technology comes along must allow for very short depreciation lives and correspondingly high costs of capital. Otherwise, the model implicitly assumes either that innovation ends with that new technology or that innovation will proceed slowly enough that the new technology will be efficiently depreciated before it must be replaced. As neither is necessarily the case in the real world, and less likely still in the world of telecommunications, firms may rationally wait to replace new equipment even when it is statically efficient to deploy a new technology.

Q. In addition to the potential for wasting the economic value and foregoing efficient "anticipatory" delay, which you discuss above, are there other costs that might make complete replacement of the network less efficient than incremental replacement?

A. Yes. There are two additional factors that might raise the costs of complete replacement compared to incremental replacement.

First, any time a firm will incur sunk costs in a changing and uncertain economic environment, it must build a risk premium into its cost analysis. The greater the uncertainty of the environment in which that sunk investment is made, the higher the risk premium that figures into the firm's capital costs. *Un*anticipated technological change is not factored into depreciation and thus causes some sunk costs to be unrecoverable. Similarly, a firm always faces the possibility that demand will not materialize and that the prices it can charge for the goods or services at issue will not cover sunk costs.

This risk is particularly acute for investment in network elements because the advent of competition has rendered retail demand less certain, while providing no assurance that competitors will continue to demand UNEs, which ILECs are obligated to provide, for their own retail offerings. An unregulated firm must, in making forward-looking investment decisions, manage the risk that its market share will change and that its capacity investments today will prove inefficient tomorrow. An ILEC faces that risk, plus another: its investments in facilities are not only for plant to provide its own retail offerings, but also for network facilities its competitors might use for their offerings. The ILEC effectively has to build capacity that the CLECs will use to serve their own retail customers, but the CLECs in turn are free to abandon those facilities after any length of time to use their own or other alternative facilities. Thus, even if the ILEC perfectly manages the risk of changes in demand for its retail services, it might still wind up with stranded costs due to changes in CLECs' demand for UNEs.

The added risk faced by ILECs is similar to what major car rental agencies would face if they were required to lease cars to new competitors at incremental cost and could not bind those competitors to fixed, long-term contracts. The incumbent agency would run the risk that at any time (perhaps, for example, when a new car model comes out) the competitors might drop their leases, buy their own new cars, and leave the incumbent with an excess supply of cars on which it has not recovered its costs. This risk is in addition to the risk the incumbent faces with regard to losing market share to the new entrant (or any other competitor). The ability of the new rental companies to drop their leases at will and to purchase their own cars makes every car the incumbent agency buys to lease out to the competitor a very risky investment. The same risk inheres in every bit of network capacity an ILEC installs in anticipation of CLECs' demand for UNEs.

Such uncertainty over technology and demand conditions raises the risk of loss and hence requires the firm to add a risk premium to the expected costs of investment. In a full replacement model, the exposure to such risk and uncertainty is much higher than in an incremental replacement model and requires a correspondingly higher risk premium on the cost side of the investment analysis. A consequence of this is that the anticipated rate of return will have to be higher to induce investment under a complete replacement model than under a model of incremental replacement.

A second reason that complete replacement is likely to be less efficient than incremental replacement is that the depreciation costs in a model of instantaneous and complete network replacement would be quite high. Indeed, a firm would not invest in new technology unless it thought it could fully recover its costs of that technology before having to replace it. As Dr. Lacey explains in his testimony, the appropriate depreciation life for an asset that will frequently have to be replaced is the time until the next event that triggers replacement.[2] Where technological change is frequent, depreciation lives under a total replacement model will be short and the rate of depreciation will be high in order for the firm fully to recover its investment during the allowable interval. When assets are not assumed to be replaced each time technology changes, their economic lives can be longer and period-by-period depreciation costs decline.

Depreciation allowances and risk-adjusted costs of capital may be particularly high when a firm is subject to a regulatory process that periodically assumes the network is successively and instantaneously replaced with new technology. In that context, the firm will anticipate successive price reductions and have to adjust risk and depreciation accordingly. One economic analysis filed in the Commission's local competition proceedings calculated that, given the sunk costs at issue in building telecommunications networks, the capital costs under such a full-replacement rule would be, after the necessary risk and depreciation adjustments, two to three times the costs of capital for efficient, incremental network investment.[3]

There may, in addition, be another practical reason not to assume construction of a new, state-of-the-art network. It is extremely difficult to know what the costs of

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[2] *See* Testimony of Dr. John Lacey at 8.

[3] GTE Comments, Reply Affidavit of Professor Jerry A. Hausman, CC Docket No. 96-98 (May 16, 1996).

constructing an entirely new network would truly be. Indeed, for a firm to assume wholesale construction of the most advanced network could well cause it to arrive at higher cost estimates than it would reach through an incremental, forward-looking cost approach. The reason for this is that the incremental costs of expanding or replacing network facilities are not necessarily constant as the volume of new equipment being purchased grows. Replacing 100 route miles of copper with fiber this year might cost C, but that does not mean that replacing 100,000 route miles this year will cost 1000 x C. It might cost much more if the heightened demand for fiber deployment increases the price of fiber cable and wages of workers needed to install it. If the supply curves for necessary labor and material inputs are upward sloping, which is a conventional economic assumption, then one cannot assume that the costs of an incremental change in network technology scale to the costs of an *immediate and total* replacement of the existing network. That is an additional reason that an efficient firm would, in calculating the most efficient technology mix going forward, use existing plant where cost-effective to do so and replace it incrementally with more advanced technology where not.

Q. Is there any evidence to support the incremental nature of technological change in telecommunications?

A. Yes. Empirical examination of the deployment of new technology in U.S. telecommunications networks confirms the incremental nature of network development and optimization. In the course of research unrelated to this testimony, I have examined the deployment patterns of several important telephone system technologies in the years following their initial introduction.[4] These include automatic switching, touch-tone (DTMF) dialing, electronic stored program control switching, SS7 signalling, digital switching, and fiber-optic transport. In each case, I examined the time it took for the new technology to be deployed in 30 percent of the relevant points in the telephone network. For the cases listed above, the times for such degree of deployment ranged from 4 years for SS7 and touch-tone to 14 years for electronic stored program control switching. And in each case, the empirical path of deployment over time followed a "sigmoidal" or S-shaped pattern: deployment was initially flat and slow, then became steeper as deployment accelerated, and finally flattened out again as technology matured or superseding innovations came along.

Those results have several important implications for assessing forward-looking cost models. First, replacement of installed plant is incremental and may take many years. Second, the pace of replacement will vary for different technologies and, therefore, for different network elements. And third, deployment of a new technology may level off or slow well before it has completely replaced the technology that preceded it, counseling caution in setting the length of planning periods during which current engineering guidelines remain in force.

Q. How long, then, should the planning horizon for an efficient firm be?

A. As already discussed above, to calculate the optimal cost level to which firms strive, but probably never reach (because the optimum is a moving target that changes over time

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[4] Howard Shelanski, "Competition and Deployment of New Technology in U.S. Telecommunications," 2000 *University of Chicago Legal Forum* 85 (2000).

with technology and demand conditions), the planning period should be long enough that as many inputs as possible are variable but not so long that the proper future network configuration is speculative and, hence, subject to costly prediction errors. In practice, firms must balance several factors in choosing their planning horizon. These include: (1) efficient replacement of existing plant with more advanced facilities; (2) uncertainty about the pace of technological change; and (3) uncertainty about demand conditions in the future for different network services. A firm might realistically be able to look only a couple of years down the road with any confidence based on today's engineering assumptions and predictions. Longer planning periods might in fact create higher costs through investment that turns out, in light of later demand and technological developments, to have been mistaken. That risk weighs towards shorter planning periods, and must be factored in by economically rational firms.

Q. Managing risk is clearly important in making efficient, forward-looking investment decisions and in setting certain parameters in a cost study. But how does risk relate to the purposes of TELRIC that you discussed at the beginning of this testimony?

A. Risk is very important both to the incentives of the incumbent network operator and to the incentives of new entrants. Consider first the incentives of an incumbent making risky investments in its network. If a firm were constrained to cover its costs without any adjustment for risk and uncertainty, then it simply would not undertake investments whose returns were not assured: the firm would be unable to recover its losses on investment that did not produce net returns but would recover only its costs on the successful investments. If firms cannot factor a risk premium into their costs, and eventually the prices they charge, they will underinvest in replacing and improving their networks. This problem is particularly acute where investment involves sunk costs that cannot be salvaged and redeployed. Accordingly, an incumbent's ability to include a risk premium in its investment analysis is important to the objectives of the Commission's TELRIC rules.

There is a corresponding effect on the incentives of new entrants. If TELRIC bases prices on costs without addition of an appropriate risk premium, then new entrants get to free ride on the investment risks taken by the incumbent. They can decide to use network elements if they decide that to do so is in their interests, or else they can choose to enter the local exchange market by providing service over their own facilities. Note that this discretionary demand by entrants for network elements is itself a source of uncertainty for incumbents trying to make efficient investment decisions. But, more importantly, if a proper risk factor is not added to the incumbent's costs, a new entrant can get the benefits of an incumbent's investments without bearing the full, risk-adjusted costs of those investments. A local competitor would, of course, have to bear those risk-adjusted costs if it were making its own network investments. The CLEC would therefore have incentive to exercise its free "option" to rely on the incumbent's investment rather than to build its own facilities. But, because the CLEC is not paying for its share of the ILEC's true investment risks, the CLEC's investment decision is distorted away from facilities-based competition and biased towards using the incumbent's network elements. This would be contrary to TELRIC's goal of providing efficient market entry incentives.

Q. Does your analysis, by allowing for a cost model to reflect continued use of existing plant, support recovery of the embedded costs of an incumbent's network?

A. No. It is important to distinguish embedded costs of the existing network from the costs of using existing network facilities on a forward-looking basis. My analysis supports using installed plant where doing so is more efficient than replacing that plant, but it recognizes that not all past and present costs of existing plant that remains in use will necessarily be recovered. It might be that new technology has come along that causes the *economic* value of an existing network element to decline as discussed above, even though a large amount of the original fixed costs of that element have yet to be recovered. An efficient forward-looking cost model should adjust for the risk that costs might get stranded in the future and become unrecoverable, but that is distinct from recovery of embedded costs that have actually accrued. The unrecovered fixed costs stranded by unanticipated changes in demand or technology are "embedded" and, in my analysis above, are not recovered. Consistent with this analysis, Verizon VA's cost model does not recognize those embedded costs. Consideration of existing plant in the model is simply not the same thing as consideration of embedded costs.

Q. What, in sum, should Verizon VA's forward-looking cost model try to measure?

A. The model should try to measure the costs that Verizon VA, acting efficiently, will incur going forward to provide relevant network functions. Economic principles dictate that prices should reflect the costs of the resources that an efficient firm will use in production. In this case, a correct cost study should measure the costs that Verizon VA expects to incur to provide network elements based on the current state of its network, the best technology currently available to update its network, and the efficient replacement of installed network facilities with new technology over the course of the planning period.

III. VERIZON VA'S COST STUDY IS, TO THE EXTENT POSSIBLE UNDER THE TELRIC FRAMEWORK, BASED ON CORRECT ECONOMIC PRINCIPLES. (JDPL Issues II-1-a to II-1-c; II-2-a to II-2-c)

Q. Based on your analysis, does Verizon VA's cost study incorporate the correct economic approach?

A. Verizon VA's model applies correct, forward-looking economic principles as closely as possible given the constraints of the TELRIC rules. Verizon VA's cost study is based on long-run, forward-looking costs and reflects the principles discussed in the last section. It incorporates engineering guidelines that begin with the existing network and then call for deployment of the most efficient mix of technologies going forward. The cost study adopts a reasonable planning period and properly accounts for the constraints on the value of current network facilities imposed by new technology and by market competition.

As I discuss below, however, Verizon VA's recurring cost model does make one assumption that differs from the efficient, incremental replacement model discussed in the first part of this testimony. And that assumption could cause Verizon VA's model to understate costs somewhat. Specifically, Verizon VA bases its recurring cost estimates not on the network configuration that will in fact be in place at the end of the planning period, but on the network that would be in place if the forward-looking engineering assumptions had been fully implemented network-wide. As I will explain below, Verizon VA's model may thus give CLECs the benefit of lower output-adjusted operating and maintenance costs than Verizon VA will in fact incur, without